

# Analysis of Shenzhen's Tourism Strategy under the Coupling of Big Data and GIS

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Received: 11 Jan 2025; Received in revised form: 13 Feb 2024; Accepted: 19 Feb 2025; Available online: 24 Feb 2025

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**Abstract**— The booming development of big data has brought unprecedented opportunities and broad perspectives to the study of tourism resources. By mining and deeply analyzing various data, potentially valuable information can be discovered, providing accurate cognition and clear direction for the development of the tourism industry. Combining geographic information system (GIS) technology can effectively conduct spatial analysis and visual display of tourism resources, which not only helps with destination planning and resource optimization but also provides strong support for the sustainable development of the tourism industry. This article is based on a literature review method, a GIS spatial analysis method, and a SWOT-AHP analysis method and combines multi-source big data (such as Gaode-Map POI data, OSM transportation road network data, etc.) with geographic spatial big data to analyze the current situation and strategies of tourism development in Shenzhen. Finally, based on the analysis results of the spatial distribution of tourism resources, transportation accessibility, SWOT analysis, and strategic quadrilateral, corresponding suggestions are proposed for the high-quality development strategy of tourism in Shenzhen.

**Keywords**— Big Data; Geographic Information System (GIS) ; Point of Interest (POI) ; Traffic Accessibility, Strengths-weaknesses-opportunities-threats—Analytic Hierarchy Process (SWOT-AHP)

## I. INTRODUCTION

As an important way to promote economic growth, create job opportunities, and meet people's aspirations for a better life, tourism is a key industry to improve people's quality of life [1]. In the era of rapid social and economic development, in order to achieve the goal of high-quality development, the tourism industry should actively explore the development path of transformation and upgrading so as to better meet people's needs for a better life.

With the development of big data and geographic information system (GIS) technology, research in the tourism field has gradually deepened both domestically and

internationally. Big data technology provides rich data resources for the tourism industry, while GIS technology provides powerful tools for data integration and spatial analysis, especially in tourism resource spatial analysis, scenic area planning, and tourist behavior prediction. For example, Pan and Cong (2014) used geographic information system (GIS) technology and various scientific methods such as nearest neighbor index and K-index to deeply analyze the spatial distribution characteristics of A-level tourist attractions in China, in order to reveal their inherent laws and trends[2]; Zhu et al. (2018) explored the spatial distribution pattern of different types of tourist

attractions in a region based on GIS, and used the grid cost method to calculate the spatial accessibility of attractions [3]; Suthanaya and Suwarningsih (2023) proposed an infrastructure development strategy for Bali based on accessibility measurement of travel distance and time in tourist locations [4].

In the process of researching and formulating tourism development strategies, the SWOT method is widely used as a systematic evaluation tool to comprehensively consider internal and external factors of the industry in order to screen out the most suitable development strategy [5]. This method has been widely applied and practiced in the field of tourism planning since the 1990s. For example, Lei and Wang (2015) used Liquan County in Shaanxi Province as an example to analyze the development strategy of the rural tourism industry using traditional SWOT analysis [6]. However, the traditional SWOT method has a strong subjectivity, so some scholars have added other models to the SWOT method to seek quantitative support. For example, Xiao et al. (2019) conducted a qualitative and quantitative study on the tourism development strategy of Nanyang City by constructing the SWOT-AHP model [7]; Fan et al. (2023) used Changbai Mountain in China as an example to identify and rank tourism development strategies based on SWOT, QSPM, and Analytic Hierarchy Process (AHP) [8].

Shenzhen is located in the southern coastal area of China, and its superior geographical location endows it with unparalleled natural sea scenery and profound cultural heritage, making it one of the most abundant tourism resources in China. However, there is still a gap in the research on the development of Shenzhen's tourism industry: in terms of research content, there is a lack of overall research on tourism resources, and most of it is

focused on the classification of tourism resources such as sports tourism and park distribution; in terms of research methods, only a few scholars have conducted qualitative analyses such as SWOT and tourism image perception on its tourism industry, lacking quantitative research.

With the vigorous development of the economy, the tourism industry in Shenzhen has entered a new stage of high-quality development. Therefore, this article organically integrates big data technology with geographic information systems (GIS) and conducts a qualitative and quantitative analysis of Shenzhen's tourism resources and industry development through the construction of the SWOT-AHP model, providing scientific and reasonable tourism industry development strategy suggestions.

## II. STUDY AREA

Shenzhen is a coastal city in southern China, located in the southern part of Guangdong Province, adjacent to Hong Kong. Located south of the Tropic of Cancer, between longitude 113° 43' and 114° 38' E, and latitude 22° 24' and 22° 52' N. The total area of the city is 1997.47 square kilometers. As of May 2022, Shenzhen has 9 administrative districts under its jurisdiction (Figure 1).

According to the "List of A-level Tourist Attractions in Guangdong Province" released by the Department of Culture and Tourism of Guangdong Province, as of 2024, Shenzhen has a total of 17 3A-level and above tourist attractions, 58 three-star and above hotels, and rich natural, cultural, and leisure sightseeing spots. At the same time, as a modern city, Shenzhen has rich and unique theme parks, modern buildings, and prosperous commercial shopping centers. Its complete modern tourism industry system provides tourists with a rich and colorful tourism experience.

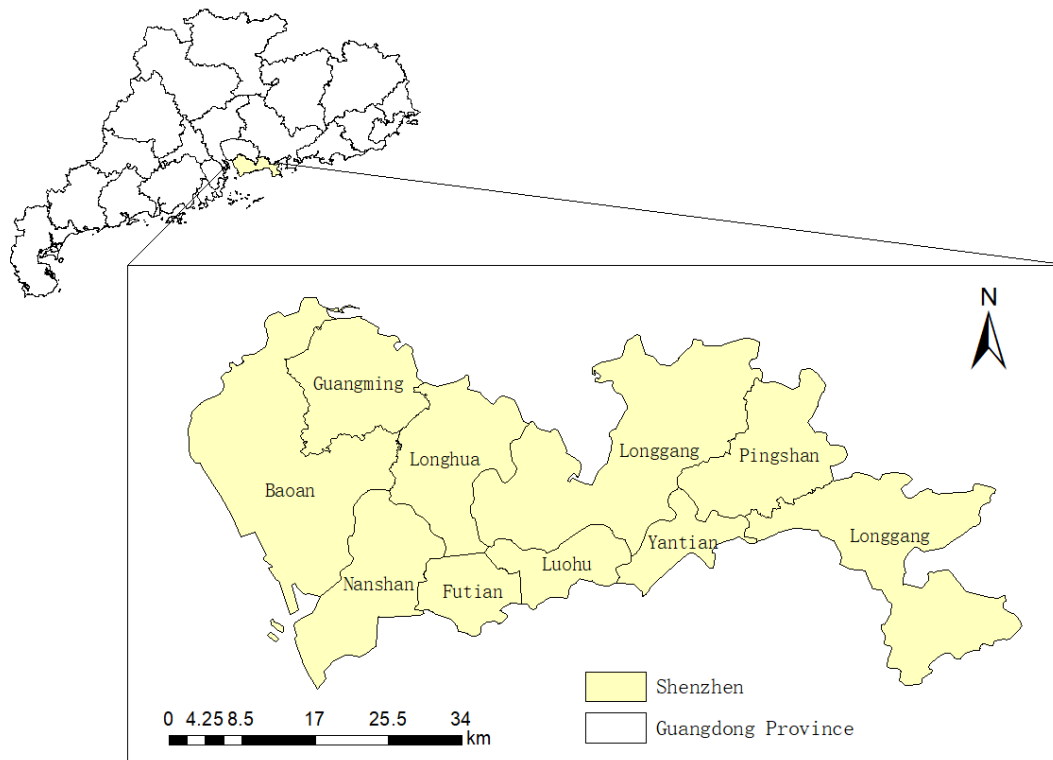


Fig.1 Administrative District of Shenzhen City

### III. METHODS AND DATA PROCESSING

#### 3.1 Methods

##### 3.1.1 Kernel Density Analysis

The Kernel Density Analysis (KDA) method is used to accurately calculate the unit density of point and line features within a specific domain. This method aims to visually display the distribution of discrete measurement values in a continuous area, providing users with clearer and more accurate data analysis basis [9]. Therefore, the analysis of spatial clustering areas mostly uses distribution density to measure. This article uses the ArcGIS's KDA tool to calculate the distribution density of tourism resources in Shenzhen. The KDA formula is as follows:

$$\int_n (x) = \frac{1}{nh} \sum_{i=1}^n k \left[ \frac{x-x_i}{h} \right] \quad (1)$$

In the formula:  $\int_n (x)$  is the estimated kernel density,  $k$   $[(x-x_i)/h]$  is the kernel function,  $h>0$  is the bandwidth,  $x - x_i$  represents the distance from the point to the sample point, the larger the value of  $\int_n (x)$ , the denser the distribution, and the higher the distribution density of POI.

##### 3.1.2 Standard Deviation Elliptical

The Standard Deviation Ellipse (SDE) method, first proposed by Lefever in 1926, is a commonly used analysis

method aimed at delving into the spatial distribution characteristics of point datasets. Starting from the average center, calculate the standard deviation of the X and Y coordinates to determine the axis of the ellipse. Among them, the long axis represents direction, the short axis represents range, and the flatness further describes the characteristics of direction [10].

##### 3.1.3 Accessibility Analysis

The accessibility measurement methods include buffer analysis, network analysis, the minimum distance method, spatial syntax, and the inverse distance weighting method [11]. Different methods have their own advantages and disadvantages. Based on the actual situation and research needs in Shenzhen, this article selects the weighted average method and network analysis method for accessibility research..

Weighted average travel time is the average time spent traveling from one location to all other locations [12]. This article selects the weighted average travel time as an indicator to calculate the average travel time from each point to all locations in the study area. Measure the accessibility level of the research area from the perspective of time weighting. The calculation formula is as follows:

$$A_i = \frac{\sum_{j=1}^n T_{ij} M_j}{\sum_{j=1}^n M_j}, M_j = \sqrt{R_j G_j} \quad (2)$$

Network Analyst is a technique and method used to evaluate the reachability between different nodes in a network. Based on the OD cost matrix, an accessibility calculation is performed to obtain the isochronous circle of accessibility for A-level scenic spots in Shenzhen, and an accessibility analysis map is generated in GIS. The formula for calculating the OD cost matrix is as follows:

$$A_k = \frac{\sum_{d=1}^n T_{kd}}{n} \quad (3)$$

### 3.1.4 SWOT-AHP Analytic Hierarchy Process

SWOT analysis is a widely used strategic management tool used to evaluate the internal strengths and weaknesses of a company and industry development, as well as external opportunities and threats. SWOT stands for S (strengths), W (weaknesses), O (opportunities), and T (threats). It is a qualitative analysis method used to determine an

organization's competitive advantages and ways to improve and optimize organizational strategies and tactics [13]. Through SWOT analysis of the tourism industry, we can comprehensively understand the competitive advantages and challenges of tourism destinations or industries, providing important references for formulating and adjusting tourism strategies to achieve sustainable development of the tourism industry.

Analytic Hierarchy Process (AHP) is a unique decision analysis method that combines qualitative and quantitative analysis methods to achieve a systematic and hierarchical decision-making process. This method was officially proposed by the renowned American operations researcher T. L. Saaty in the mid-1970s, aiming to provide decision-makers with more accurate and effective decision support through scientific and rational means [14]. Its model includes the goal level, criterion level, and alternative level (Figure 2). Through the AHP, the weights of various factors can be determined, helping decision-makers make scientific and objective decisions, thereby better promoting the development of the tourism industry and the sustainable development of destinations.

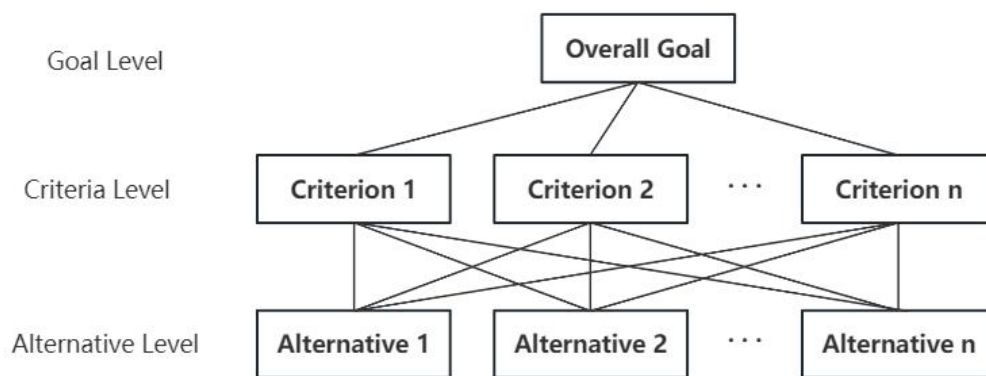


Fig.2 the hierarchical representation of Analytic Hierarchy Process (AHP) Model

The SWOT-AHP analysis method combines the advantages of SWOT qualitative analysis and AHP quantitative analysis. Through AHP analysis, the results of SWOT qualitative analysis are transformed into a quantitative model to determine the weight values of influencing factors, thereby assisting the decision-making process. The advantage of combining SWOT analysis with AHP is to improve the scientific, systematic, and accurate nature of decision-making.

## 3.2 Data Processing

### 3.2.1 POI data of tourism resources

This article uses Gaode-Map to obtain POI data for tourist attractions in Shenzhen, determines the location of each tourist resource point through latitude and longitude coordinates, and then obtains relevant spatial attributes through the Gaode-Map API, obtaining a total of more than 17,000 POI data. After filtering, removing duplicate items, and reclassifying the obtained POI data, 2,555 valid POI

data were obtained. According to the basic attributes of tourism resources, they were divided into three categories: natural tourism resources, cultural tourism resources, and

economic tourism resources, and ten subcategories (Table 1).

*Table 1 POI Classification of Tourist Attractions in Shenzhen*

Main category	Subclass	Number of POIs/piece	Proportion/%	Basic Types
Natural	Biological landscape,	1350	52.80	Botanical Garden, Zoo, Park
	Geomorphic landscape,			Mountains and hills
	Water scenery,			Ocean, beach, water sports
	Natural synthesis			World Natural Heritage Sites
Cultural	Historical site,	473	18.51	Red relics, memorial halls
	Ethnic customs and traditions,			Featured villages, temples, and religious sites
	Cultural integration			World Cultural Heritage
Economic	Sightseeing tours,	732	28.65	Featured buildings and exhibition centers
	Shopping and entertainment,			Shopping centers and commercial streets
	Leisure vacation			Holiday Resort

### 3.2.2 Transportation Accessibility

Obtain road data through the API of OpenStreetMap (OSM), import the downloaded data files into ArcGIS, and convert it to a suitable coordinate system for analysis. Firstly, classify the roads and provide graphic and textual explanations for each classification on the OSM website

(<http://wiki.openstreetmap.org/wiki/Key:highway>). Then, based on the actual situation in the research area of Shenzhen, assign speed values. The calculation formula is road length 60/(speed 1000) to obtain the speed of each level of road (Table 2).

*Table 2 Speed table of roads at all levels in Shenzhen*

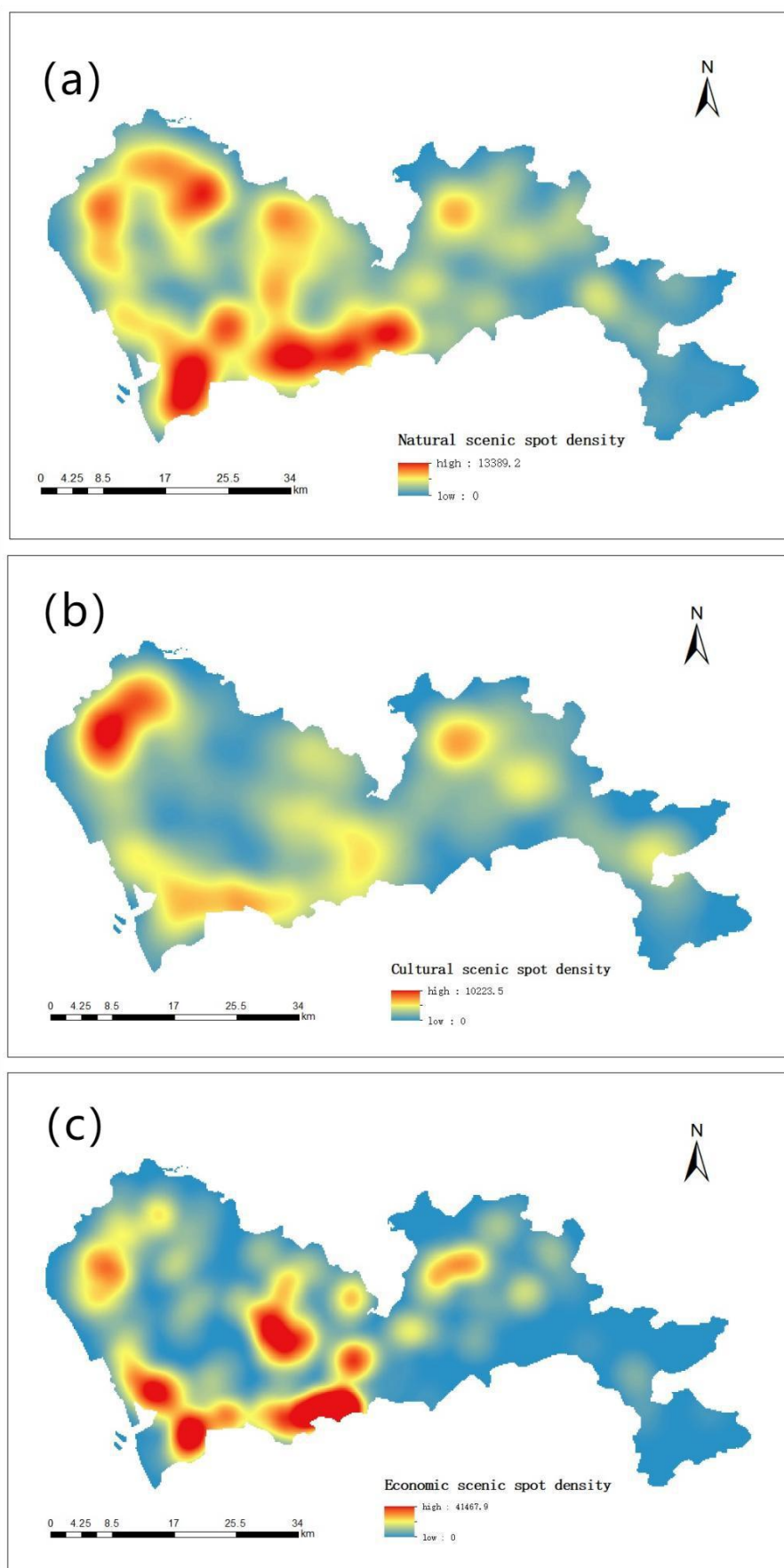
Road grade	Motorway	Trunk	Primary	Secondary
Speed/(km/h)	110	80	60	45

## IV. RESULTS AND ANALYSIS

### 4.1 KDA Results

Conduct a KDA on the three major types of scenic spots in Shenzhen: natural, cultural, and economic (Figure 3). Overall, the concentration of tourism resources in Shenzhen presents an orderly distribution pattern.

Comparing and ranking these three types of resources, it can be clearly seen that the agglomeration degree of economic tourism resources (Figure 3c) is the highest, followed by natural tourism resources (Figure 3a), while the agglomeration degree of cultural tourism resources (Figure 3b) is the lowest.



*Fig.3 Core Densities of Various Scenic Spots*



Firstly, the high degree of agglomeration of economic tourism resources is mainly due to Shenzhen's status as a special economic zone in China and its highly developed economic environment. Shenzhen has globally renowned commercial districts, modern shopping centers, and various high-end hotels, all of which are important factors in attracting tourists.

Secondly, although the degree of aggregation of natural tourism resources is not as high as that of economic tourism, Shenzhen's natural scenery and ecological environment are equally attractive. Shenzhen is located on the coast of the South China Sea, with beautiful beaches and clear waters, making it a great destination for seaside tourism. At the same time, Shenzhen has a rich variety of parks and nature reserves, such as Shenzhen Bay Park and Dameisha Seaside Park, which provide visitors with opportunities to get close to nature and relax.

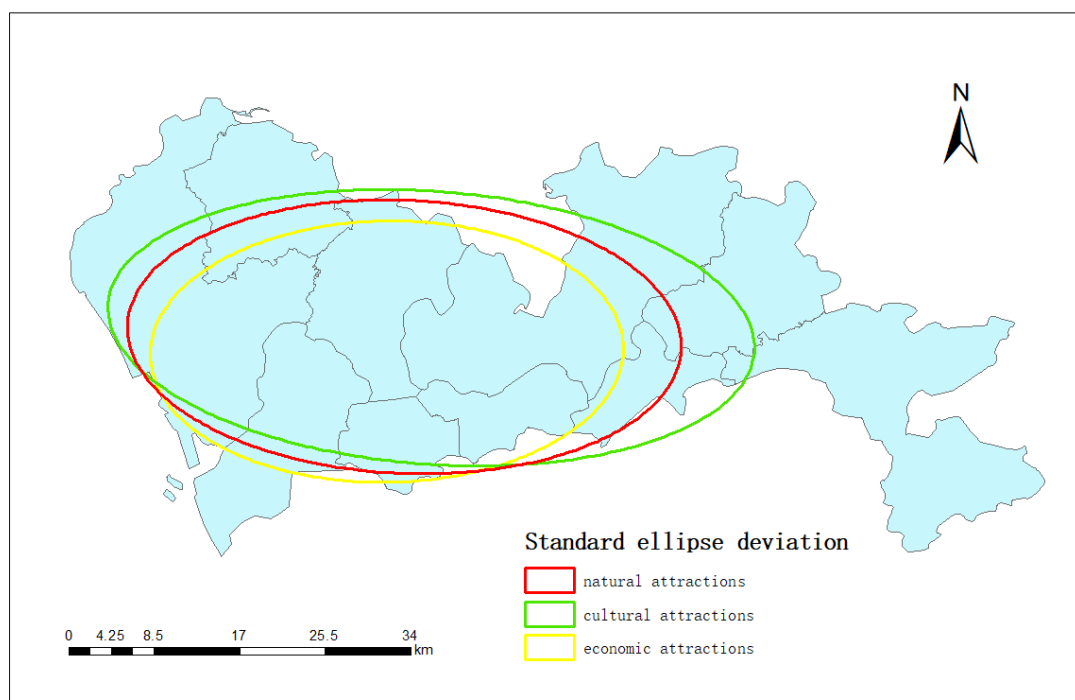
Finally, the degree of aggregation of cultural tourism resources is relatively low, but this does not mean that Shenzhen has no highlights in cultural tourism. Shenzhen is an immigrant city with diverse cultural backgrounds and

rich folk culture. However, due to the relatively short history of the city, compared to other cities with a long history and culture, Shenzhen has relatively fewer cultural tourism resources. Nevertheless, Shenzhen still has some cultural activities and attractions with local characteristics, such as the Shenzhen Museum and the Shenzhen Grand Theatre, which showcase the city's history and cultural heritage.

Overall, the concentration of tourism resources in Shenzhen presents a trend of economy>nature>culture. This ranking reflects the unique advantages of Shenzhen as an economic special zone, while also pointing out that Shenzhen still needs further improvement and development in terms of cultural tourism.

#### 4.2 SDE Results

The SDE can provide a comprehensive and in-depth analysis of the spatial directional distribution characteristics of various tourist attractions. By calculating the standard deviation ellipse, draw the standard deviation ellipses of various types of tourist attractions in Shenzhen (Figure 4).



*Fig.4 Standard Deviation Ellipses of Various Scenic Spots*

From the figure 4, it can be seen that overall, the distribution direction of the three types of tourist attractions is roughly in an east-west direction, and the overall range is

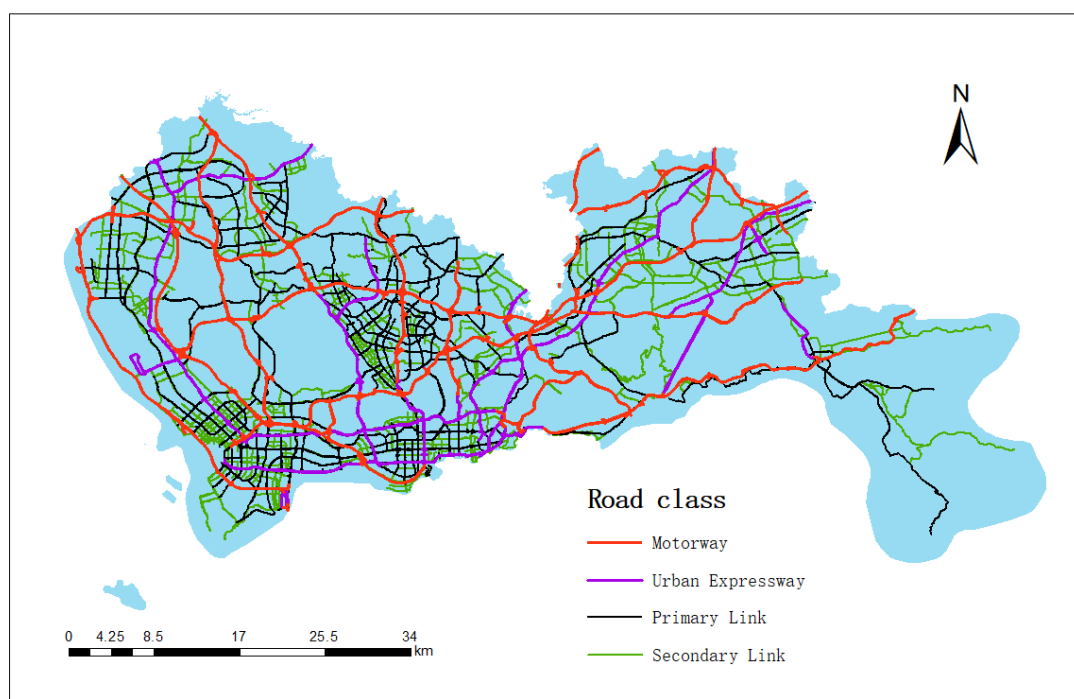
in the central part of Shenzhen, where the central old city area is located. From the perspective of the differences in ellipses of various types, the ranking of their areas from low

to high is economic > natural > cultural. The smaller the elliptical area, the closer the distribution of each location is to the center of gravity. Therefore, according to the standard deviation ellipse analysis results, economic tourist attractions are more concentrated in the center, followed by natural attractions, and finally cultural attractions. This further validates the correctness of POI kernel density analysis.

### 4.3 Transportation Accessibility

#### 4.3.1 Analysis of Shenzhen's Road Network

After processing the road network downloaded from OSM, the road distribution map of Shenzhen (Figure 5) can be obtained. It can be concluded that the road network structure of Shenzhen presents a distinct grid-like feature, with main roads and branch roads crisscrossing, jointly constructing a dense and orderly road network, which plays an important role in promoting transportation between tourist sources and destinations.



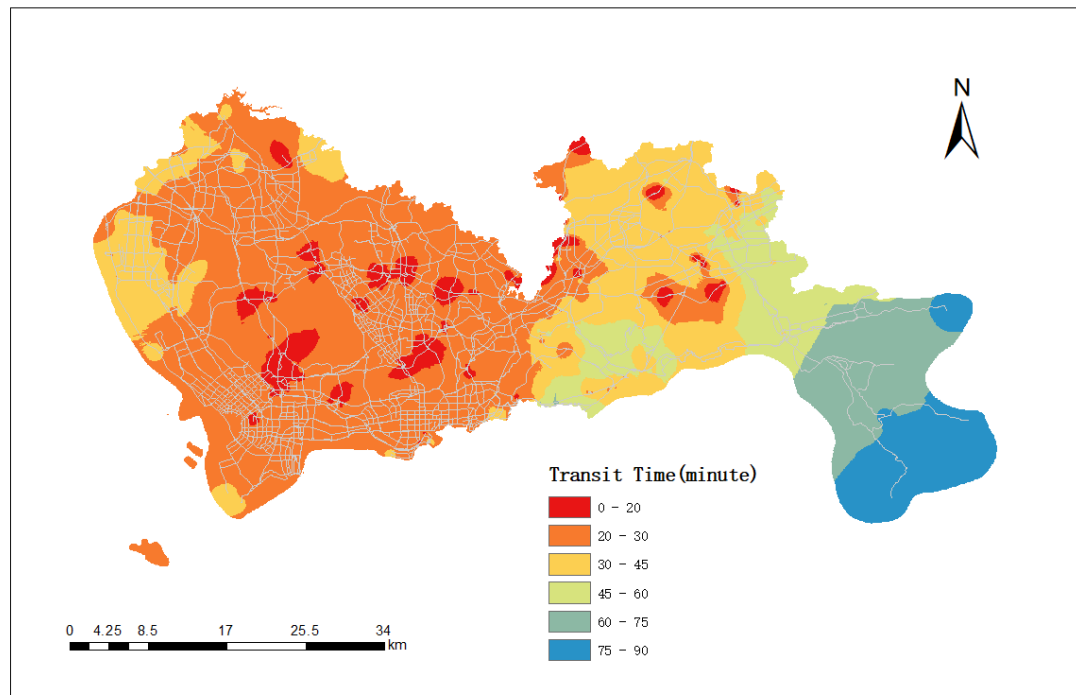
*Fig.5 Shenzhen Road Network*

#### 4.3.2 Comprehensive Transportation Accessibility

Create a new network dataset for accessibility analysis, and use formula (2) to calculate the average travel time from one location to all other locations in Shenzhen's road network, which is the weighted average travel time of comprehensive transportation. This results in the

comprehensive accessibility pattern of Shenzhen (Figure 6). The accessibility of Shenzhen city is characterized by a multi-core circle distribution, gradually weakening from the center to the periphery, and the average travel time in most areas is 20-30 minutes.





*Fig.6 Comprehensive Transportation Accessibility in Shenzhen*

The accessibility advantage center area is mainly distributed at the intersection of highways and gradually forms a hierarchical structure as it expands outward. This accessibility feature is mainly due to the grid layout of Shenzhen's road network, which makes road intersections relatively dense and traffic flow large.

In order to improve the efficiency of transportation operations, multi-level intersections, overpasses, and other transportation facilities have been set up at the intersections of highways and some roads, thus forming a comprehensive accessibility advantage area at the intersection of highways. Nanshan, Futian, Longhua, Luohu, Bao'an, Guangming District, and other areas constitute the second circle of comprehensive accessibility, with a weighted average travel time mainly ranging from 21 to 30 minutes. The urban outskirts of Bao'an and Guangming districts, as well as Longgang district, constitute the third circle, with a weighted average travel time mainly concentrated between 31 and 45 minutes. In contrast, the road network distribution in Pingshan District, Yantian District, and Dapeng New District is relatively sparse, and their geographical locations are relatively remote, so their accessibility level is relatively low.

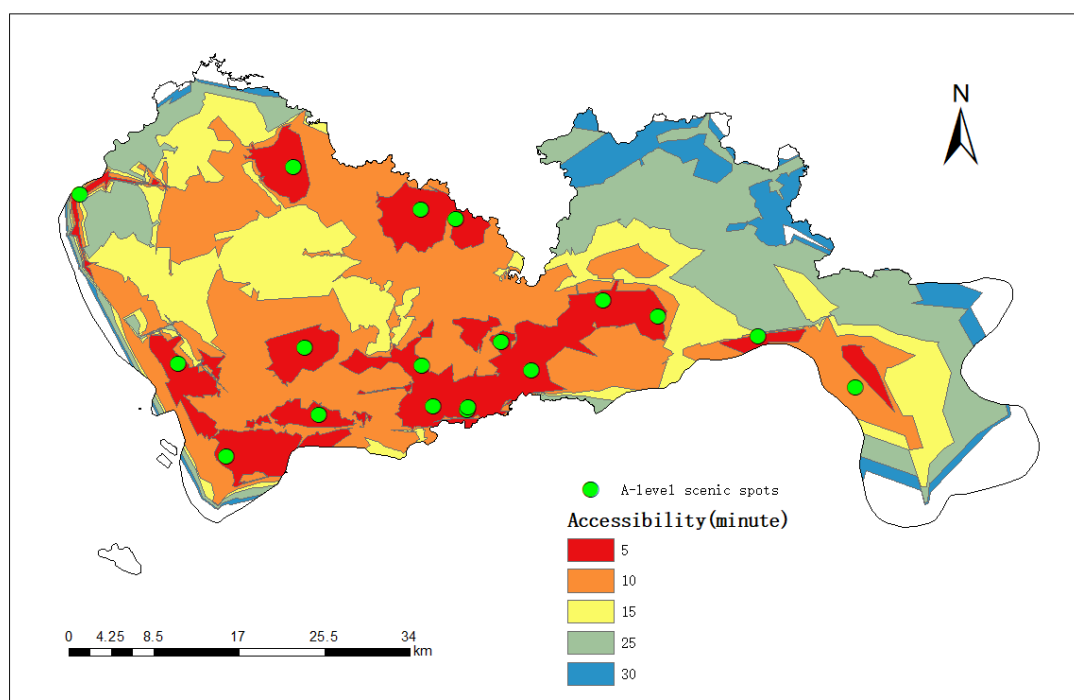
#### **4.3.3 Transportation accessibility of A-level scenic spots**

The isochronous circle model refers to the maximum spatial range that can be covered based on specific time constraints and the existing road network structure. This model can accurately show the changes in the radiation range of the target site under different time conditions and provide strong data support for decision-making [15]. Using various 3A-level and above scenic spots in Shenzhen as the destination for the Origin-Destination (OD) cost matrix analysis and road nodes at all levels in Shenzhen as the starting point, the accessibility model is established, calculated, analyzed, and the spatial pattern is displayed through formula (3) to obtain the isochronous distribution map of A-level scenic spots in Shenzhen (Figure 7).

According to the isochronous circle chart, most A-level scenic spots in Shenzhen perform well in terms of spatial accessibility. Except for one A-level scenic spot in Dapeng New District, all other A-level scenic spots are distributed in 5-minute equal time circles, which reflect the relatively developed transportation network in Shenzhen and provide convenient travel conditions for tourists. Tourists can reach these attractions in a short period of time, thereby improving the convenience and experience of tourism. However, it is worth noting that the transportation conditions in Dapeng New Area are relatively lagging

behind, which to some extent leads to slightly longer times

for tourists to reach the A-level scenic spots in the area.



*Fig.7 Traffic Accessibility of A-level Scenic Spots in Shenzhen*

#### 4.4 SWOT Analysis

##### 4.4.1 Strengths

###### 1. High economic benefits (S1)

According to the Shenzhen Statistical Yearbook released by the Shenzhen Bureau of Statistics, the total tourism revenue in Shenzhen reached 138.4 billion yuan in 2020, which has recovered to 81.4% compared to before the epidemic. Domestically, its tourism recovery ranks among the top. During the period of 2021-2023, after continuous recovery and adjustment, the tourism industry in Shenzhen has been steadily improving, showing a trend of annual growth (Table 3).

The prosperity of Shenzhen's tourism industry has significantly promoted economic growth, facilitated cultural exchanges, and enhanced the city's charm and influence. The diverse tourist attractions within the city, including natural beauty, historical sites, and cultural districts, have attracted numerous tourists and increased tourism revenue. The expansion of the tourism industry has also driven the improvement of services such as hotels, catering, and transportation, creating a large number of job opportunities and stimulating the development of related industries, becoming a key factor in promoting urban economies.

*Table 3 Total tourism revenue and number of visitors in Shenzhen from 2021 to 2023*

Year (year)	Total tourism revenue (in billions of yuan)	Year on year growth (%)	Number of tourists received (in billions)
2021	1550	12%	1.6
2022	1780	15%	1.8
2023	2114	15.2%	2

###### 2. Convenient transportation (S2)

Shenzhen has become a popular tourist destination for many tourists due to its convenient transportation network. According to the traffic accessibility analysis in Figure 5-7,

the highways, urban expressways, main roads, and secondary roads together form an efficient and smooth road network system, greatly reducing the average travel time. At the same time, the accessibility of tourist attractions is

high, and tourists can easily visit various attractions to experience the natural scenery and cultural charm of Shenzhen. This transportation environment undoubtedly injects strong vitality into Shenzhen's tourism industry and lays a solid foundation for its future development.

### **3. Rich tourism resources (S3)**

Shenzhen has diverse tourism resources, including natural landscapes, cultural heritage and modern architecture. Awarded the title of "Top 10 Best Travel Destination Cities in the World in 2019" by Lonely Planet magazine, and also included in the list of "Top 10 Tourist Cities in the World" by the World Tourism Council. In the field of urban tourism, China Merchants Shekou International Cruise Home Port has become the only modern international cruise home port in South China that integrates "sea, land, air, and rail" with its unique advantages, adding new highlights and brands to urban tourism.

#### **4.4.2 Weaknesses**

##### **1. Insufficient supply of tourism construction space (W1)**

As a rapidly developing modern city, Shenzhen's increasing demand for land use has put significant pressure on the construction of tourism projects. At present, there is a prominent problem in the development of tourism projects in Shenzhen, where "projects and funds are complete, but land is scarce and difficult to implement". At the same time, there are still certain shortcomings in the comprehensive development of tourism land and the composite utilization of project space, and the utilization efficiency of tourism land resources and project space resources urgently needs to be improved.

##### **2. Insufficient supply of high-end tourism products and cultural resources (W2)**

Compared to other Chinese cities, Shenzhen's historical and cultural heritage is relatively weak. According to the POI scenic spot classification results in Table 1, cultural and historical attractions only account for 18.51%. There is a shortage of high-quality tourism resources, and resource-based tourism products are unable to meet tourists' pursuit of high-quality tourism. The exploration of cultural resources such as red culture, innovative culture, Lingnan culture, and marine culture is insufficient, and the tourism development model needs to be reformed.

##### **3. Insufficient linkage between tourism and consumption (W3)**

In the current society, tourism has become an important driving force for economic development, and its close integration with the consumer market is of great significance for promoting local economic growth and enhancing urban image. However, Shenzhen has obvious shortcomings in the linkage between tourism and consumption. According to statistics, the per capita consumption of tourists in Shenzhen in 2023 is about 1213 yuan/person, which is far less than tourist cities such as Guangzhou, Beijing, Shanghai, and Hangzhou. The emergence of this phenomenon reflects that Shenzhen still needs to strengthen its development in the tourism consumption market. On the other hand, it also highlights the shortcomings of Shenzhen in the linkage between tourism and consumption. The lack of linkage between tourism and consumption not only affects the development of Shenzhen's tourism industry but also restricts the expansion of the consumer market.

#### **4.4.3 Opportunities**

##### **1. Superior international exchange environment (O1)**

During the 14th Five-Year Plan period, relied on the driving advantages of the Guangdong-Hong Kong-Macao Greater Bay Area and the Shenzhen Pilot Demonstration Zone. Shenzhen is committed to building an internationally renowned tourist shopping and consumption destination and world-class tourist city, injecting new momentum into the high-quality development of the tourism industry and promoting industrial transformation and upgrading.

##### **2. Driven by technological innovation (O2)**

The deepening development of the global technological revolution has brought transformative power to the tourism industry through technologies such as 5G, big data, and artificial intelligence. Shenzhen actively builds smart tourism with its technological advantages, launches the "i-Tour Shenzhen" platform, and prioritizes the deployment of 5G networks to enhance tourist experience.

##### **3. Strong policy support (O3)**

Shenzhen has issued the Implementation Plan for the Creation of Shenzhen Comprehensive Tourism Demonstration Zone, which has been successfully selected as one of the first batch of national comprehensive tourism

demonstration zones. Yantian District and Nanshan District have been awarded the titles of national and provincial demonstration zones, respectively. In addition, Shenzhen has been selected as one of the first national pilot cities for cultural and tourism consumption and has implemented a 144-hour visa-free transit policy, optimized international transit services, and improved tourism convenience and internationalization levels.

#### 4.4.4 Threats

##### 1. Tourist inclination (T1)

Changes in tourists' travel preferences may lead to a decrease in demand for traditional popular attractions and tourism projects, affecting their revenue. For example, if more tourists prefer natural and cultural tourism and Shenzhen is known for its modern urban landscape and shopping tourism, then existing tourism products may not be able to meet the demand.

##### 2. Intense competition in the tourism industry (T2)

Against the backdrop of increasingly fierce competition in the domestic and international tourism markets, the tourism industry in Shenzhen is facing severe challenges from other cities, countries, and even the world.

With the booming development of tourism in other regions, some tourist resources have been attracted, further intensifying the competitive situation in the Shenzhen tourism market.

##### 3. Public Health and Safety Challenges (T3)

Against the backdrop of global public health and safety challenges, the tourism industry in Shenzhen is facing a series of complex and severe tests. The pressure on the inbound tourism market, uncertainty in the recovery of the international tourism market, and public health and safety issues have all had varying degrees of impact on Shenzhen's tourism industry.

#### 4.5 SWOT-AHP Model

##### 4.5.1 Construction of Indicator System

By analyzing and researching the development of Shenzhen's tourism industry and organizing its SWOT analysis results, the goal level, criterion level, and alternative level of Shenzhen's tourism industry development can be determined, and a SWOT-AHP hierarchical structure model for Shenzhen's tourism can be constructed. (Figure 8)

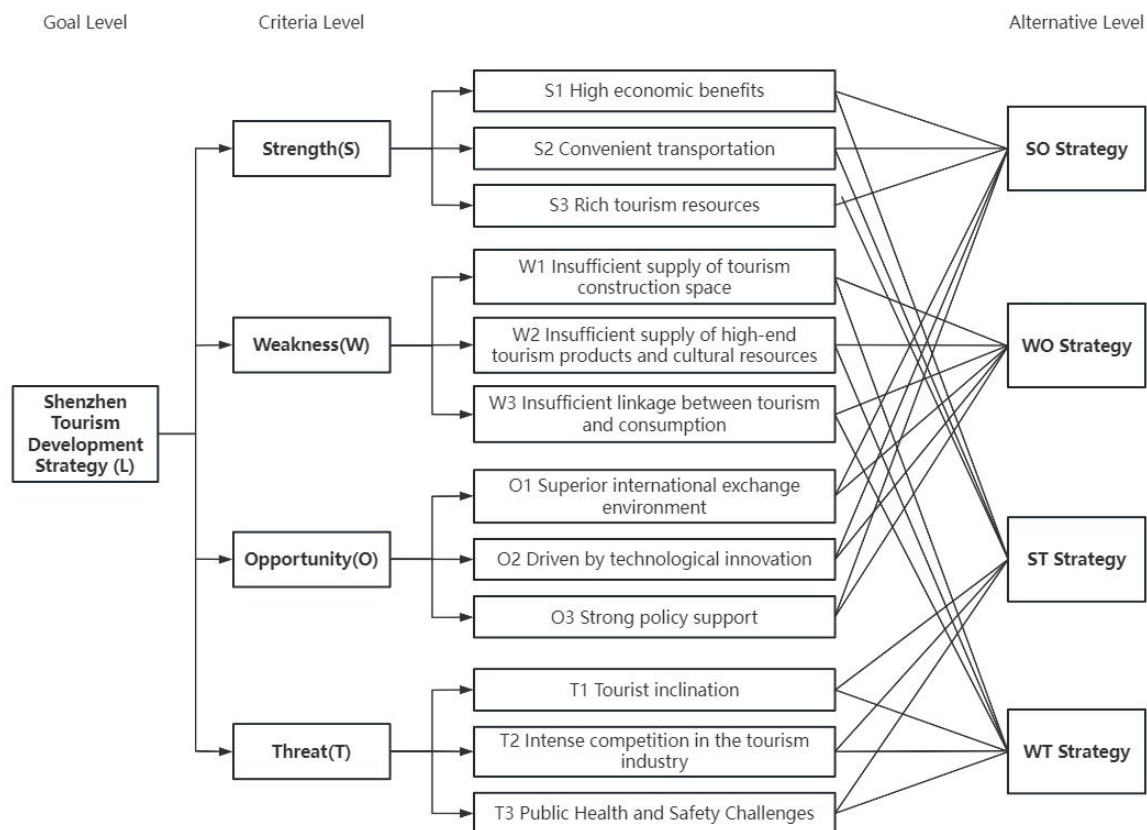


Fig.8: Hierarchical Structure of Shenzhen's Tourism Development Strategy

#### 4.5.2 Construction of judgment matrix and calculation of weights

Based on the scoring results of the questionnaire survey, a pairwise judgment matrix was organized and summarized. The weights and maximum eigenvalues were calculated, and consistency tests were conducted on the judgment matrix. The CR values were all less than 0.1 and the results are shown in Table 4-8.

The greater the weights of each influencing factor in SWOT, the greater its impact. By calculating the weights of

the development strategy indicators for Shenzhen's tourism industry (Table 9), it can be concluded that Shenzhen's tourism development is opportunities > strengths > weaknesses > threats. Abundant tourism resources (S3) are the most influential factor among strengths, insufficient supply of high-end tourism products and cultural resources (W2) is the most influential factor among weaknesses, technological innovation (O2) is the most influential factor among opportunities, and fierce competition in the tourism industry (T2) is the most influential factor among threats.

Table 4 SWOT judgment matrix of the Shenzhen tourism industry

	S	W	O	T	Weight	Maximum eigenvalue	CI	CR	Consistency (CR<0.1)
S	1	2	1/2	3	0.2771	4.0310	0.0103	0.0115	adopt
W	1/2	1	1/3	2	0.1611				
O	2	3	1	4	0.4658				
T	1/3	1/2	1/4	1	0.0960				

Table 5 Judgment matrix of Shenzhen's tourism strengths (S)

	S1	S2	S3	Weight	Maximum eigenvalue	CI	CR	Consistency (CR<0.1)
S1	1	2	1/2	0.2766	3.0055	0.0028	0.0048	adopt
S2	1/2	1	1/5	0.1285				
S3	2	5	1	0.5949				

Table 6: Judgment matrix of Shenzhen's tourism weaknesses (W)

	W1	W2	W3	Weight	Maximum eigenvalue	CI	CR	Consistency (CR<0.1)
W1	1	1/2	2	0.2973	3.0092	0.0046	0.0079	adopt
W2	2	1	3	0.5390				
W3	1/2	1/3	1	0.1638				

Table 7 Judgment matrix of Shenzhen's tourism opportunity (O)

	O1	O2	O3	Weight	Maximum eigenvalue	CI	CR	Consistency (CR<0.1)
O1	1	1/4	1/2	0.1373	3.0183	0.0092	0.0158	adopt
O2	4	1	3	0.6232				
O3	2	1/3	1	0.2395				

Table 8 Judgment matrix of Shenzhen's tourism threat (T)

	T1	T2	T3	Weight	Maximum eigenvalue	CI	CR	Consistency (CR<0.1)
T1	1	1/2	4	0.3151	3.0020	0.0010	0.0017	adopt
T2	2	1	7	0.6025				
T3	1/4	1/7	1	0.0824				

Table 9 Indicator Weights for Shenzhen Tourism Development Strategy

Primary Indicator	Weight	Secondary indicator	Weight	Comprehensive weight
S	0.2771	S1 High economic benefits	0.2766	0.0766
		S2 Convenient transportation	0.1285	0.0356
		S3 Rich tourism resources	0.5949	0.1648

W	0.1611	W1 Insufficient supply of tourism construction space	0.2973	0.0478
		W2 Insufficient supply of high-end tourism products and cultural resources	0.5390	0.0868
		W3 Insufficient linkage between tourism and consumption	0.1638	0.0264
O	0.4658	O1 Superior international exchange environment	0.1373	0.0640
		O2 Driven by technological innovation	0.6232	0.2903
		O3 Strong policy support	0.2395	0.1116
T	0.0960	T1 Tourist inclination	0.3151	0.0302
		T2 Intense competition in the tourism industry	0.6025	0.0578
		T3 Public Health and Safety Challenges	0.0824	0.0079

#### 4.5.3 Strategic Quadrilateral

The degree of influence of each strategic factor is called strength [16]. Intensity=weight \* intensity score, reflecting the impact of various strategic elements on the high-quality development of tourism in Shenzhen. Positive and negative values respectively indicate promotion and hindrance. The estimated strength of each factor is represented by a score ranging from 0 to 5, where S and O have positive scores, while W and T have negative scores. Multiply the weights of the indicators in Table 9 by the strength of the factors to obtain the total strength of S, W, O, and T (Table 10).

- (1) Total strength intensity:  $\sum S_i/n_s=0.4243$  (2) Total weakness intensity:  $\sum W_i/n_w=-0.2189$   
 (3) Total opportunity intensity:  $\sum O_i/n_o=0.6371$  (4) Total

threat intensity:  $\sum T_i/n_t=-0.1353$

From this, it can be concluded that the coordinates of S, W, O, and T are located in the four quadrant coordinates. The corresponding coordinates of the four factor strength values are S (0.4243, 0), W (-0.2189, 0), O (0, 0.6371), and T (0, -0.1353). Then, these four coordinates are located through connecting lines to obtain the strategic quadrilateral (Figure 9).

By calculating the area of the four triangles in the strategic quadrilateral, determine the development strategy that Shenzhen's tourism should adopt. The calculation shows that  $S_{\Delta ASO}=0.1351 > S_{\Delta AWO}=0.0697 > S_{\Delta AST}=0.0287 > S_{\Delta AWT}=0.0148$ , which leads to SO strategy > WO strategy > ST strategy > WT strategy.

Table 10 Strength of Various Factors

Factor	Sub-factors	Comprehensive weight	Intensity score	Intensity	Total intensity
S	S1	0.0766	4	0.3064	0.4243
	S2	0.0356	4	0.1424	
	S3	0.1648	5	0.8240	
W	W1	0.0478	-3	-0.1434	-0.2189



	W2	0.0868	-5	-0.4340	
	W3	0.0264	-3	-0.0792	
	O1	0.0640	3	0.1920	
O	O2	0.2903	4	1.1612	0.6371
	O3	0.1116	5	0.5580	
	T1	0.0302	-5	-0.1510	
T	T2	0.0578	-4	-0.2312	-0.1353
	T3	0.0079	-3	-0.0237	

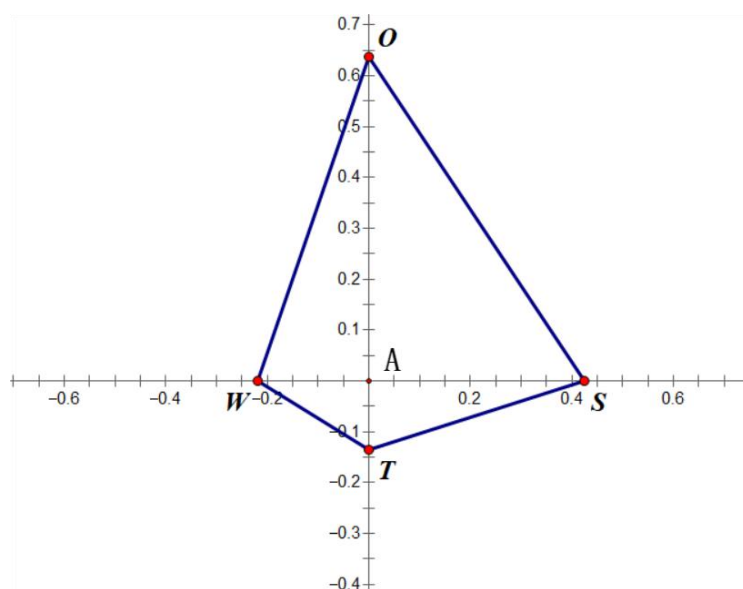


Fig.9 Shenzhen Tourism Industry Strategy Quadrilaterals

## V. CONCLUSION AND SUGGESTIONS

This article uses the coupling method of big data and GIS to analyze the kernel density, standard deviation ellipse, and transportation accessibility of various tourist resource POIs in Shenzhen and obtains the spatiotemporal distribution characteristics and influencing factors of various tourist attractions in Shenzhen. Combined with the SWOT-AHP analysis results, an objective analysis was conducted on the current situation and internal and external strengths and weaknesses of Shenzhen's tourism industry. Finally, based on the above analysis results, tourism strategies and recommendations for Shenzhen are derived.

### 5.1 Conclusion

The following are the conclusions drawn from this study:

(1) POI analysis of tourism resources: Based on the classification and sorting results of tourism resources and POIs crawled from big data in Shenzhen, it is found that the tourism resources in Shenzhen exhibit diverse characteristics and the tourism system is relatively complete. However, in terms of cultural resources, Shenzhen appears relatively scarce, which to some extent affects the richness and attractiveness of its tourism resources. In summary, Shenzhen has certain advantages in tourism resources, but there are also some shortcomings.

(2) Spatial feature analysis: Through kernel density and standard deviation ellipse analysis, the clustering of tourism resources in Shenzhen city presents the following order from high to low: socio-economic resources > natural resources > cultural resources. The center of tourism resource aggregation is located in the central part of Shenzhen, where the central old city area is situated. This pattern highlights the significant advantages of Shenzhen as an economic special zone in the tourism field while also revealing that there is still room for improvement and development in the field of cultural tourism in Shenzhen.

(3) Transportation accessibility analysis: Shenzhen has a well-developed transportation network and overall high transportation convenience. The comprehensive accessibility of Shenzhen is distributed in a multi-core circle pattern, decreasing from the center to the surrounding areas, with an average travel time of mostly 21-30 minutes. Most A-level scenic spots are distributed in a five-minute isochronous circle, with good spatial accessibility and short travel time for tourists to reach tourist attractions. Overall, Shenzhen has a high level of convenient tourism transportation.

(4) SWOT analysis: Through qualitative SWOT analysis, it was found that the internal strengths of its tourism industry are high economic benefits, convenient transportation, and abundant tourism resources. These factors provide a solid foundation for the formulation of its tourism strategy and high-quality development. However, there are also internal weaknesses, such as an insufficient supply of tourism construction space, an inadequate supply of high-end tourism products and cultural resources, and insufficient linkage between tourism and consumption, which restrict the further development of its tourism industry. External opportunities include a favorable international exchange environment, technological innovation, and policy support, which have created favorable external conditions for the vigorous development of tourism in Shenzhen in the future. External threats include tourist preferences, intense competition in the tourism industry, and public health and safety challenges, which pose certain threats to the high-quality development of tourism in Shenzhen.

(5) SWOT-AHP analysis: Through quantitative analysis of SWOT-AHP, the total strength intensity

$S=0.4243$ , the total weakness intensity  $W=-0.2189$ , the total opportunity intensity  $O=0.6371$ , and the total threat intensity  $T=-0.1353$ . Visualize the total intensity as a strategic quadrilateral and calculate the area of each strategic triangle, obtaining  $S_{\Delta ASO} > S_{\Delta AWO} > S_{\Delta AST} > S_{\Delta AWT}$ . Therefore, the development of Shenzhen's tourism industry mainly adopts the SO strategy that combines internal strengths and external opportunities, and secondly, it also needs

## 5.2 Suggestions

Based on the above research conclusions, corresponding suggestions are proposed: The development of Shenzhen's tourism industry mainly adopts a strategy that combines internal strengths with external opportunities, namely the SO strategy. At the same time, it is also necessary to take into account the strategies for dealing with weaknesses and threats, namely the WO strategy, in order to achieve comprehensive and balanced development.

### 1. Leverage strengths; empower high-quality tourism development with technology.

Technological innovation plays a core role in the construction of the contemporary tourism industry system [17]. In the study, the technological innovation is the second-level indicator with the highest weight in the SWOT analysis strength index (S), and it is also the factor with the highest comprehensive weight (Table 9). Thus, the development of Shenzhen's tourism industry should be driven by technological innovation as the core driving force. Comply with the digital trend, promote the integration of "Internet plus tourism," develop new business forms such as cloud tourism and cloud live broadcast, and meet diversified needs. Accelerate the construction of smart tourism scenic spots, utilize technologies such as 5G and big data to enhance tourist experience, and promote the digital upgrading of scenic spots. Meanwhile, it needs to create technology tourism products, leveraging the platforms of Science and Education City and Science City, showcasing Shenzhen's technological innovation achievements, and launching the "Technology+Tourism" route.

### 2. Seize the opportunities; create high-quality tourism resources.

Tourism resources are the primary factor of tourism production, and characteristic resources are the foundation

of competition in the tourism industry [18]. Rich tourism resources are the secondary indicator with the highest weight in the opportunity index (O) of the SWOT analysis and also the second highest comprehensive weight factor (Table 9). Shenzhen has abundant natural resources and urban tourism resources. We should make full use of coastal resources, develop coastal tourism and cruise economy, and build an international coastal tourism brand. At the same time, leverage the advantages of urban shopping and exhibition resources, promote the integration of tourism with consumption, exhibition, sports, and other industries, and improve the level of tourism products and services.

### **3. Improve disadvantages; promote integrated development of culture and tourism.**

China is currently relying on cultural resources and integrating new formats of culture and tourism through structural adjustment [19]. The POI analysis results indicate that there is insufficient supply of cultural tourism resources and high-end tourism products in Shenzhen. This factor has the highest weight in the SWOT analysis of the weakness index (W) (Table 9), which poses the greatest obstacle to the development of Shenzhen's tourism industry. To address the issue of insufficient cultural tourism resources, we should explore the historical and cultural characteristics of Shenzhen and create red tourism brands and creative cultural tourism products. Promote the integration of cultural and intangible cultural heritage resources with tourism, build cultural blocks, cultivate characteristic cultural tourism consumption circles, and enhance cultural experiences.

### **4. Responding to threats, building international and domestic tourism hub cities**

Against the backdrop of the sustained booming development of the tourism industry, cross regional tourism cooperation has become an inevitable choice for the development of tourism industries in various countries [20]. The fierce competition in the tourism industry has the highest weight in the SWOT analysis threat index (T) (Table 9). Shenzhen should deepen regional tourism cooperation, promote the coordinated development of cultural tourism in the Guangdong-Hong Kong-Macao Greater Bay Area, and expand the international tourism market. Strengthen cooperation with countries along the "Belt and Road," improve the international airline network

and inbound tourism services, and build an international tourism hub city.

Through the above strategies, Shenzhen's tourism industry will achieve high-quality development, further enhancing the city's attractiveness and competitiveness.

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